



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/091,106	03/05/2002	John Commander	CEDE 2036	5919
321	7590	06/16/2006	EXAMINER	
SENNIGER POWERS ONE METROPOLITAN SQUARE 16TH FLOOR ST LOUIS, MO 63102			WONG, EDNA	
			ART UNIT	PAPER NUMBER
			1753	

DATE MAILED: 06/16/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/091,106

Applicant(s)

COMMANDER ET AL.

Examiner

Edna Wong

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 June 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-7, 17 and 65-73 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7, 17 and 65-73 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on June 5, 2006 has been entered.

This is in response to the Amendment dated June 5, 2005. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Response to Arguments

Claim Objections

Claim **65** has been objected to because of minor informalities.

The objection of claim 65 has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 103

I. Claims **1-7 and 65-69** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Barstad et al.** (US Patent No. 6,444,110 B2) in combination with **Creutz, deceased et al.** (US Patent No. 4,110,176).

The rejection of claims 1-7 and 65-69 under 35 U.S.C. 103(a) as being unpatentable over Barstad et al. in combination with Creutz, deceased et al. has been withdrawn in view of Applicants' amendment.

II. Claim 17 has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Barstad et al.** (US Patent No. 6,444,110 B2) in combination with **Creutz, deceased et al.** (US Patent No. 4,110,176).

The rejection of claim 17 under 35 U.S.C. 103(a) as being unpatentable over Barstad et al. in combination with Creutz, deceased et al. has been withdrawn in view of Applicants' amendment.

Response to Amendment

Claim Rejections - 35 USC § 112

Claims 1-7, 17 and 65-73 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1

line 9, "the overall chloride content" lacks antecedent basis.

lines 9-10, "the overall sulfur content" lacks antecedent basis.

Claim 17

line 12, "the chloride content and sulfur content" lack antecedent basis.

line 13, "the chloride content and sulfur content" lack antecedent basis.

line 20, it appears that the "recrystallization and grain growth at a reduced rate" is the same as the reduced rate of recrystallization and grain growth recited in claim 17, lines 9-10. However, it is unclear if it is.

Claim Rejections - 35 USC § 103

I. Claims 1-7 and 65-71 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Creutz, deceased et al.** (US Patent No. 4,110,176) in combination with **Barstad et al.** (US Patent No. 6,444,110 B2).

Creutz teaches a method for electroplating a copper deposit (col. 1, lines 9-15) onto a circuit device substrate (= printed circuit board) having electrical interconnect features (= through-hole) [col. 2, lines 15-23], the method comprising:

(a) immersing the circuit device substrate into an electroplating bath including:

(i) ionic copper (= $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) [col. 5, line 65],

(ii) a suppressor (= polyethylene glycol, MW 9,000) [col. 4, lines 14-41; and col. 5, line 68],

(iii) an accelerator (= $\text{HSO}_3\text{-(CH}_2)_3\text{-S-S-(CH}_2)_3\text{-SO}_3\text{H}$) [col. 4, line 42]

to col. 5, line 13; and col. 6, line 1], and

(iv) an effective amount of a defect reducing agent (= 0.04 to 1000 mg/l of a reaction product of an alkoxyated polyalkylenimine with an alkylating agent) [cols. 6-8, claim 1; and abstract], wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine (col. 3, lines 67 to col. 4, lines 13; and col. 5, lines 23-57); and

(b) electroplating the copper deposit from said bath (col. 1, line 9-15) onto the substrate to fill the features (= through-hole plating) [col. 2, lines 15-23].

A source of the ionic copper is copper sulfate pentahydrate (= $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) [col. 5, line 65].

The electroplating bath comprises 1.0 mL/L of said defect reducing agent (= 0.04 to 1000 mg/l of a reaction product of an alkoxyated polyalkylenimine with an alkylating agent) [cols. 6-8, claim 1; and abstract].

The electroplating bath comprises 2.0 mL/L of said defect reducing agent (= 0.04 to 1000 mg/l of a reaction product of an alkoxyated polyalkylenimine with an alkylating agent) [cols. 6-8, claim 1; and abstract].

The electroplating bath comprises 5.0 mL/L of said defect reducing agent (= 0.04 to 1000 mg/l of a reaction product of an alkoxyated polyalkylenimine with an alkylating agent) [cols. 6-8, claim 1; and abstract].

The method of Creutz differs from the instant invention because Creutz does not disclose the following:

a. Wherein the circuit device substrate is a semiconductor integrated circuit device substrate having electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs therein, as recited in claim 1.

Like Creutz, Barstad teaches a method for electroplating a copper deposit. Barstad teaches that copper plating has been employed on circuit board manufacturing to plate outer layers where final circuitry is defined. More recently, copper plating has been employed in semiconductor chip manufacture to provide chip interconnections (col. 1, lines 36-65; and col. 7, lines 56-65). Conventional copper plating systems can be suitable for plating vias and trenches as small as 300 nm with 4:1 aspect ratios (col. 2, lines 20-25). Barstad shows the copper electroplating of through hole walls of a printed circuit board substrate (col. 8, Example 1) and the copper electroplating of microvias of a semiconductor microchip wafer (col. 8, Example 2) using similar copper electroplating baths.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the circuit device substrate described by Creutz with wherein the circuit device substrate is a semiconductor integrated circuit device substrate having electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs therein because conventional copper plating systems would have been suitable for plating vias and trenches as small as 300

nm with 4:1 aspect ratios as taught by Barstad (col. 1, lines 36-65; col. 2, lines 20-25; col. 7, lines 56-65; and (col. 8, Examples 1 and 2).

Furthermore, Creutz teaches similar copper electroplating bath chemistries (cols. 5-6, Example 1) as disclosed in Barstad et al. (col. 8, Examples 1-2), where Barstad et al. teach that such copper plating systems are suitable for circuit board manufacturing and semiconductor chip manufacturing.

b. Wherein the effective amount of the defect reducing agent increases the overall chloride content and the overall sulfur content of the copper deposit, as recited in claim 1.

Creutz teaches 0.04 to 1000 mg/l of a reaction product of an alkoxylated polyalkylenimine with an alkylating agent (cols. 6-8, claim 1; and abstract).

Creutz teaches a method in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that the 0.04 to 1000 mg/l of a reaction product of an alkoxylated polyalkylenimine with an alkylating agent would have increased the overall chloride content and the overall sulfur content of the copper deposit because similar processes can reasonably be expected to yield similar results.

c. Whereby the occurrence of protrusion defects from superfilling, surface roughness, and voiding due to uneven growth are reduced, and macro-scale planarity across the wafer is improved, as recited in claim 1.

Creutz teaches a method in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that the method disclosed by Creutz would have reduced the occurrence of protrusion defects from superfilling, surface roughness, and voiding due to uneven growth, and improved the macro-scale planarity across the wafer because similar processes can reasonably be expected to yield similar results.

d. Wherein the defect reducing agent reduces high current density edge effect during electroplating, as recited in claim 2.

Creutz teaches wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine (col. 3, lines 67 to col. 4, lines 13; and col. 5, lines 23-57).

Creutz teaches a compound in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that the defect reducing agent disclosed by Creutz would have reduced high current density edge effect during electroplating because similar compounds can reasonably be expected to have similar properties.

Furthermore, it has been held that a newly discovered use or function of components does not necessarily mean the system is unobvious since this use or function may be inherent in the prior art. *Ex parte Pfeiffer* 135 USPQ 31.

e. Wherein the defect reducing agent improves distribution of deposited copper over the substrate surface, as recited in claim 3.

Creutz teaches wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine (col. 3, lines 67 to col. 4, lines 13; and col. 5, lines 23-57).

Creutz teaches a compound in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that the defect reducing agent disclosed by Creutz would have improved distribution of deposited copper over the substrate surface because similar compounds can reasonably be expected to have similar properties.

Furthermore, it has been held that a newly discovered use or function of components does not necessarily mean the system is unobvious since this use or function may be inherent in the prior art. *Ex parte Pfeiffer* 135 USPQ 31.

f. Wherein the deposit has a deposit thickness of about 1 micron and which varies by no more than about 0.2 microns across the deposit, the deposit thickness being measured from an upper surface of the deposit to the substrate surface at its thickest point, as recited in claim 4.

Creutz teaches a method in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that the method disclosed by Creutz would have deposited a deposit has a deposit thickness of about 1 micron and

which varies by no more than about 0.2 microns across the deposit because similar processes can reasonably be expected to yield products which inherently have the same properties. *In re Spada* 15 USPQ 2d 1655 (CAFC 1990); *In re DeBlauwe* 222 USPQ 191; *In re Wiegand* 86 USPQ 155 (CCPA 195).

Furthermore, the thickness of the deposit is well within the skill of one having ordinary skill in the art to determine dependent upon the intended use of the device (e.g., the thickness for a printed circuit board vs. the thickness for a semiconductor wafer), particularly to the environment to which the device will encounter, which would be most suited for the application of the device, absent evidence to the contrary.

As to the deposit thickness being measured from an upper surface of the deposit to the substrate surface at its thickest point, if the deposit thickness varies by no more than about 0.2 microns across the deposit, then measuring the deposit thickness at its thickest point would have revealed this, and that any other point beyond this would have been outside this range.

g. Wherein the defect reducing agent facilitates deposition of a thinner overall deposit to achieve a minimum thickness across the substrate than an overall deposit required to achieve such minimum thickness by electroplating without said defect reducing agent, as recited in claim 5.

Creutz teaches wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine (col. 3, lines 67 to col. 4, lines 13; and col.

5, lines 23-57).

Creutz teaches a compound in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that the defect reducing agent disclosed by Creutz would have facilitated deposition of a thinner overall deposit to achieve a minimum thickness across the substrate than an overall deposit required to achieve such minimum thickness by electroplating without said defect reducing agent because similar compounds can reasonably be expected to have similar properties.

Furthermore, it has been held that a newly discovered use or function of components does not necessarily mean the system is unobvious since this use or function may be inherent in the prior art. *Ex parte Pfeiffer* 135 USPQ 31.

h. Removing a portion of the copper deposit by chemical and mechanical action to yield a level substrate, wherein an amount of copper deposit to be removed is less than an amount of copper deposit which must be removed by chemical and mechanical action to yield a level substrate in a comparable substrate electroplated without said defect reducing agent, as recited in claim 6.

When the defect reducing agent, a reaction product of benzyl chloride and hydroxyethyl polyethylenimine, would have facilitated deposition of a thinner overall deposit to achieve a minimum thickness across the substrate than an overall deposit required to achieve such minimum thickness by electroplating without said defect reducing agent, then the amount of copper deposit to be removed would have naturally

been less than the amount of copper deposit which must be removed by chemical and mechanical action to yield a level substrate in a comparable substrate electroplated without said defect reducing agent.

Chemical mechanical polishing (CMP) is conventional in the copper electroplating art to remove a portion of a copper deposit.

i. Wherein pitting corrosion from said chemical action is less severe than pitting corrosion in the comparable substrate electroplated without said defect reducing agent, as recited in claim 7.

Creutz teaches a method in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that the method disclosed by Creutz would have had pitting corrosion from said chemical action that was less severe than pitting corrosion in the comparable substrate electroplated without said defect reducing agent because similar processes can reasonably be expected to yield similar results.

j. Wherein the electroplating bath further includes sulfuric acid present in an amount between about 150 g/L and about 225 g/L, as recited in claim 65.

k. Wherein the copper sulfate pentahydrate present in an amount between about 59 g/L and about 75 g/L, as recited in claim 66.

Creutz teaches that it was found that with the additives of his invention, the acid

copper plating baths may be operated under conditions of high acid and low metal content to still obtain excellent plating results (col. 1, lines 38-54).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the electroplating bath described by Creutz with wherein the electroplating bath further includes sulfuric acid present in an amount between about 150 g/L and about 225 g/L because excellent plating results would have been obtained when the acid copper plating baths were operated under conditions of high acid and low metal content as taught by Creutz (col. 1, lines 38-54).

Furthermore, Barstad teaches a copper salt concentration of from about 10 to about 300 g/l (col. 4, lines 7-19).

Furthermore, It has been held that changes in temperature, concentration or both, is not a patentable modification; however, such changes may impart patentability to a process if the ranges claimed produce new and unexpected results which are different in kind and not merely in degree from results of the prior art, such ranges are termed "critical" ranges and Applicant has the burden of proving such criticality; even though Applicant's modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within capabilities of one skilled in the art; more particularly, where general conditions of the claim are disclosed in the prior art, it is not inventive to discover optimum or workable ranges by routine experimentation. *In re Aller*, 220 F2d 454, 456, 105 USPQ 233, 235 (CCPA 1955) and MPEP § 2144.05.

l. Wherein the sulfur content in the copper deposit is at least about 1.5×10^{18} atoms/cm², as recited in claim 70.

m. Wherein the sulfur content in the copper deposit is at least about 3.0×10^{18} atoms/cm², as recited in claim 71.

Creutz teaches copper deposits (col. 1, lines 9-15).

Creutz teaches a method in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that the method disclosed by Creutz would have produced a copper deposit having a sulfur content in the copper deposit is at least about 1.5×10^{18} atoms/cm² and a sulfur content in the copper deposit is at least about 3.0×10^{18} atoms/cm² because similar processes can reasonably be expected to yield similar results.

II. Claims 17 and 72-73 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Creutz, deceased et al.** (US Patent No. 4,110,176) in combination with **Barstad et al.** (US Patent No. 6,444,110 B2).

Creutz and Barstad are as applied for reasons as discussed above and incorporated herein.

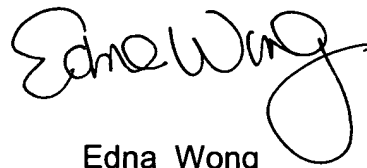
It should be noted that present claims 1-3, 5 and 17 recite how the defect regent performs in the electroplating bath. The same kind of compounds would have performed in the same manner (MPEP § 2112.01 (II)). Present claims 4 and 70-73 recite

characteristics of the copper deposit. The copper deposit is the result of performing the process and does not imply a procedure or method.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

A handwritten signature in black ink, appearing to read "Edna Wong". The signature is fluid and cursive, with the first name "Edna" and last name "Wong" clearly distinguishable.

Edna Wong
Primary Examiner
Art Unit 1753

EW
June 12, 2006